SciVerse ScienceDirect

Procedia - Social and Behavioral Sciences 29 (2011) 786 – 793

Procedia
Social and Behavioral Sciences

International Conference on Education and Educational Psychology (ICEEPSY 2011)

Factors that influence secondary school students' attitude to mathematics

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Abstract

Pupils could like, enjoy, or the opposite, could hate mathematics. Attitude could be described as a long-term positive or negative emotional disposition towards mathematics. There is a correlation between pupils' attitude towards mathematics and their mathematical results, thus it is important to develop a positive attitude towards learning mathematics. This attitude could be influenced by many factors.

In this research a questionnaire was developed for identifying the factors that influence secondary school pupils (5^{th}-8^{th} grade, 10/11 to 14/15 years old) attitude to mathematics. 337 pupils from the north-vest and central part of Romania have completed the questionnaire. The findings show that the most important factor is the teacher: the teachers' attitude to mathematics and the amount of confidence and support he/she gives to the pupil influence their attitude towards mathematics. Another important factor is how pupils think about the utility of mathematics in their everyday life. Self-efficacy and self-judgment also influence pupils' attitude towards learning mathematics.

Keywords: attitude towards mathematics; self-reaction,;self-judgment; self-efficacy; mathematics anxiety.

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doi:10.1016/j.sbspro.2011.11.306

1. Introduction

Pupils could like, enjoy, or the opposite, could hate mathematics. Attitude could be described as a long-term positive or negative emotional disposition towards mathematics (Mc Leod, 1992). Therefore this attitude are rather stable, contain both affective and cognitive factors (Goldin, 2002). A bidimensional definition of the attitude contains only the emotions and beliefs associated with mathematics (Daskalogianni & Simpson, 2000). According to a multidimensional definition, the attitude has three components: emotional response, beliefs regarding mathematics, and behaviour related to the subject (Hart, 1989). Some factors that influence attitude towards mathematics are confidence, beliefs in the importance of mathematics and its utility in practice, and mathematical anxiety (Ashby, 2009).

There is a correlation between pupils' attitude towards mathematics and their mathematical results (eg. Nicolaidou & Philippou, 2003).

The aim of this paper is to present the results of a research on the factors that influence pupils' attitude towards mathematics. The research is made among 337 secondary school pupils (10/11 to 14/15 years old, 5^{th}-8^{th} grades) and it studies how pupils' beliefs about the utility of mathematics, their self-efficacy, self-judgment, and self-reaction, respectively their teacher influence their attitude towards mathematics.

2. Theoretical background

Students' interest in mathematics, their beliefs in the utility of the mathematical knowledge in their future career or in their everyday life are important. „Belief systems are one's mathematical world view, the perspective with which one approaches mathematics and mathematical task. One's beliefs about mathematics can determine how one chooses to approach a problem, which techniques will be used or avoided, how long and how hard one will work on it, and so on." (Schoenfeld, 1985, p. 45)

Self-efficacy is students' judgments about their ability to successfully complete a task, as well as students' confidence in his/her skills to perform the task (Pintrich et al., 1993). "People's beliefs in their efficacy influence the choices they make, their aspirations, how much effort they mobilize in a given endeavor, how long they persevere in the face of difficulties and setbacks, whether their thought patterns are self-hindering or self-aiding, the amount of stress they experience in coping with taxing environmental demands, and their vulnerability to depression." (Bandura, 1991, p. 257) Self-efficacy in mathematics can be measured using self-ratings of skills regarding specific mathematics problems (Schunk, 1981). Students, who feel a high level of self-efficacy, will concentrate more easily on the tasks, use efficient strategies, manage time efficiently, and ask for help if needed (Pintrich & De Groot, 1990). But in some case extremely high self-efficacy is detrimental for learning: the student think, that she/he knows everything and doesn't need to put effort in learning. Slightly lower sense of self-efficacy led to greater mental effort, so to better learning results (Salomon, 1984).

Self-judgment is one's evaluation on his/her performance and recognition of the relationship between the achieved performance level and the quality of the learning process (Zimmerman, 2000). Learners with high self-judgment attribute their poor performance to lack of effort or time; or to the use of an inadequate strategy (Zimmerman, 1998). "The more students can take responsibility for their own learning, the more likely they are to attribute success to their own efforts. If students believe that their efforts will make a difference in what and how much they learn, then they are more likely to expend higher levels of effort in their studies." (Hagen & Weinstein, 1995, p. 53)

Self-reaction involves feelings about the achieved results: satisfaction or dissatisfaction (Zimmerman, 2002). If the student believes that he/she is making a good progress, than he/she feels satisfaction, which enhances self-efficacy and sustains motivation (Schunk, 1996). When students feel satisfaction about their performance, they are more motivated to complete the task (Schunk, 1981). As mathematics is a difficult subject for many students, the feeling of satisfaction is important for motivating students.

Mathematics anxiety involves "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). This anxiety can cause one to forget and lose one's self-confidence (Tobias, 1993) and it could be in the detriment of the good achievement in mathematics (Cooper & Robinson, 1991; Resnick, Viehe, & Siegel, 1982; Wigfield & Meece, 1988).

3. Research

The aim of the research is to find factors which influence secondary school pupils' attitude towards mathematics.

3.1. Research design

3.1.1. Hypotheses

The hypotheses of the research are:

1. One's beliefs on the utility of mathematics in his/her future career and in the everyday life influence his/her attitude towards mathematics.
2. Self-efficacy is in positive correlation with mathematics attitude.
3. Self-judgment is in positive correlation with mathematics attitude.
4. Self-reaction is in positive correlation with mathematics attitude.
5. Mathematics anxiety is in negative correlation with mathematics attitude.
6. The teacher influences pupils' attitude towards mathematics.

3.1.2. Research tool

The research tool is a questionnaire with 28 items: 5 demographical questions and 22 items related with the topic of the research. These 23 items are measured on a 5 point Likert scale from 1-strongly don't agree to 5-strongly agree. These items were developed based on the literature related with some self-regulated learning skills as self-efficacy, self-judgment and self-reaction. Cronbach's alpha reliability for the questionnaire is .81.

3.1.3. Sample

The sample is a group of 337 randomly selected secondary-school (5^{th}-8^{th} grades, 10/11 to 14/15 years old) pupils from Hungarian school from north-vest and central part (Transilvania region) of Romania. 49.7% of the respondents are boys, 50.3% girls. Regarding pupils' age, the most represented age categories are between 12 and 14 years: 29,5% of the respondents are 13 years old, 28.3% 14 years old, and 24.3% 12 years old (see Figure 1). 20.77% of the respondents are from 5^{th} grade, 21.66% from 6^{th} grade, 37.98% from 7^{th} grade, and 19.58% from 8^{th} grade. In Figure 2 the pupils' mathematics marks are represented. In Romania marks are from 1 to 10, the lowest passing mark is 5. We could observe that most of the respondents obtained a passing mark in the previous semester. Most of the respondents had one or two mathematics teachers (37.7% respectively 38.7%), 22.6% had between three and five teachers.

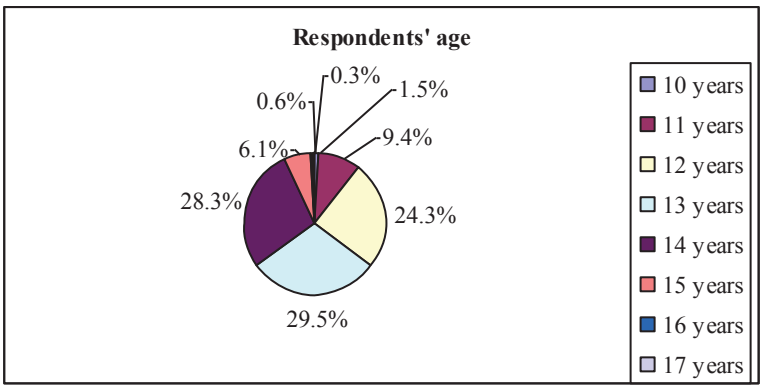

Figure 1. Respondents' age

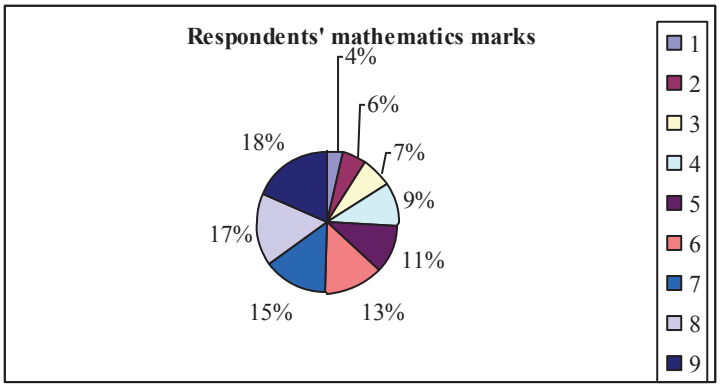

Figure 2. Respondents' mathematics marks

3.2. Results

The items are grouped into the following categories: items related with self-efficacy (Table 1), with help-seeking (Table 2), with self-judgment (Table 3), with self-reaction (Table 4), with mathematics anxiety (Table 5), with the utility of mathematics (Table 6), and with the respondents' mathematics teacher (Table 7). Each item is measured on a 5 point Likert scale from 1-strongly don't agree to 5-strongly agree. Some of the items describe a behavior typical for the related category; some of them describe the unwanted behavior. When calculating the averages, in case of an untypical behavior we have inversed the numbers (replacing 1 with 5 and vice versa, 2 with 4 and vice versa). To obtain the percentages for those who think that the given behavior is not typical for them, we have added the percentages of those, who have selected variant 1 or 2. Similarly, to get the percentages for those who say that the given behavior is typical for them, we have added the percentages of those, who have selected variant 4 or 5.

Table 1. Items related with self-efficacy

	Average	Not typical (%)	Typical (%)
I am very far from mathematics.	3.41	33.73	46.57
I am not able to be a good mathematician.	2.76	50.45	28.09
I have talent for mathematics.	2.69	46.53	30.82

Table 2. Items related with help-seeking

	Average	Not typical (%)	Typical (%)
When I don't understand something at mathematics classes, I ask my teachers immediately.	3.27	36.27	46.57
When I don't understand something at mathematics classes, I ask one of my colleagues in the break after the class.	2.70	43.92	30.27
If I can't solve my homework, I ask for help.	2.59	26.49	51.49

Table 3. Items related with self-judgment

	Average	Not typical (%)	Typical (%)
If I practiced more, I would have better results.	3.47	26.27	50.75
If I was more patient when solving problems, I would be better in mathematics.	3.59	23.35	54.79
No matter how much time I spend studying mathematics, I can't get better marks.	3.48	54.17	28.57

Table 4. Items related with self-reaction

	Average	Not typical (%)	Typical (%)
If I solve a problem correctly, I am very happy.	4.52	5.37	85.42
If I get high marks at mathematics, I feel good.	4.36	4.95	86.13

Table 5. Items related with mathematical anxiety

	Average	Not typical (%)	Typical (%)
I worry a lot because of my mathematics marks.	3.74	26.23	50.71
I am nervous before mathematics classes.	2.50	3.61	92.00

Table 6. Items related with the beliefs on the utility of mathematics

	Average	Not typical (%)	Typical (%)
Mathematics doesn't have any connection with the real life.	3.37	60.12	28.40
There is a link between mathematics and everyday life.	3.50	23.28	51.64
I will use mathematics in my life.	2.14	16.91	65.88

Table 7. Items related with the respondents' mathematics teacher

	Average	Not typical (%)	Typical (%)
My teacher explains mathematics enthusiastically.	4.02	15.48	73.21
My teacher likes mathematics.	4.74	3.56	93.18
My teacher is a good mathematician.	4.76	3.58	92.54
My mathematics teacher is one of my favorite teacher.	3.03	39.76	43.32
My teacher can arouse my interest for mathematics.	3.04	34.13	38.02
My teacher encourages me, if I have difficulties with mathematics.	3.71	19.64	58.33

Table 8 contains correlation coefficients.

Table 8. Correlations

	Attitude towards mathematics
Self-efficacy	0.468***
Help-seeking	0.182***
Self-efficacy and help-seeking	0.481***
Self-judgment	0.182***
Self-reaction	0.059
Utility of mathematics	0.162**
Anxiety	-0.083
Mathematics teacher	0.600***

* significance level .05, ** significance level .01, *** significance level .001

3.3. Discussion

In this section we will discuss the hypotheses of the research.

3.3.1. One's beliefs on the utility of mathematics in his/her future career and in the everyday life influence his/her attitude towards mathematics.

Almost one-third of the respondents think, that mathematics doesn't have any connection with real life or it can't be used in everyday life (Table 6). In Romania textbooks and national tests promote problems, which are mathematically formulated, don't have any connection with problems from real life (Marchis, 2009a; Marchis, 2009b). Thus when pupils meet a problem in their everyday life, which solution requires some mathematical knowledge, don't recognize the mathematical background or can't apply what they have learnt from mathematics.

There is a mild correlation between pupils' beliefs on the utility of mathematics and their attitude towards learning mathematics. Thus the first hypothesis is valid.

3.3.2. Self-efficacy is in positive correlation with mathematics attitude.

Almost half of the pupils consider that they are far from mathematics; one third that they are not able to be a good mathematician (Table 1). But the opposite affirmations are valid too for many of the respondents: half of the respondents think that they are able to be a good mathematician; one-third considers that they have talent for mathematics. To improve pupils' beliefs in their mathematical abilities the teacher have to take in consideration that different pupils are on a different level.

Help-seeking is also important for a success in studying mathematics. If a pupil is stacked with a problem (i.e. recalled all the previous knowledge, tried all the know methods, tried to create a new method for solving the problem, but couldn't get a correct solution), usually has two possibilities: to find a similar solved problem or to seek for the help of the teacher or of a colleague. Almost half of the pupils ask the teacher immediately as they don't understand something during the class; one third of them ask a colleague after the lesson (Table 2). Thus the percentage of those asking help is high. Regarding homework, more than half of the respondents ask for help in case of unsuccessful problem solving.

There is a strong correlation between pupils' self-efficacy and their attitude to mathematics, also between pupils' help-seeking behavior and their attitude (Table 8). The second hypothesis is valid.

3.3.3. Self-judgment is in positive correlation with mathematics attitude.

Pupils' self-judgment is high, more than half of the respondents are aware that there is a strong correlation between the effort they put in studying mathematics and their results (Table 3).

Pupils' self-judgment level is in strong correlation with their attitude to mathematics (Table 8). The third hypothesis is true.

3.3.4. Self-reaction is in positive correlation with mathematics attitude.

Pupils self-reaction level is very high (Table 4), but this is not in correlation with their attitude towards learning mathematics (Table 8). The fourth hypothesis is not valid.

3.3.5. Mathematics anxiety is in negative correlation with mathematics attitude.

Pupils have a high level of anxiety: more than half of them worry about their mathematics marks, and almost all of the respondents feel nervous before the mathematics class.

The anxiety doesn't affect pupils' attitude towards mathematics (Table 8). The fifth hypothesis is not true.

3.3.6. The teacher influences pupils' attitude towards mathematics.

Most of the pupils think that their teacher likes mathematics and he/she is a good mathematician. Three-quater of the respondents say that their teacher explains mathematics enthusiastically. More than half of the pupils get encouragements from their teacher when having difficulties with mathematics; and for almost half of the respondents the mathematics teachers in one of the favorite teacher. (See Table 7.)

The teachers strongly influences pupils' attitude towards mathematics (Table 8). The sixth hypothesis is true.

4. Conclusions, limitation and future implications

The research results show that the most important factor for attitude towards learning mathematics is the teacher. Also pupils' beliefs on the utility of mathematics in their everyday life or the real life influence their attitude towards studying mathematics. Another two factors that influence pupils' attitude are self-efficacy and self-judgment.

A limitation of the research is the sample size.

The research results show the importance of rethinking the textbook problems and national tests in Romania: the problems related with everyday life should be included.

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Acknowledgement

This work was supported by CNCSIS - UEFISCSU, project number PNII - IDEI 2418/2008.